

CLAIMS

What is claimed is:

- 1 1. A method comprising:
2 mounting an integrated circuit on a top surface of a package substrate having
3 top and bottom surface buildup layers disposed on a thermally conductive substrate
4 core, wherein a portion of the substrate core is exposed at the top surface of the
5 package substrate; and
6 attaching a heat spreader to the package substrate, the heat spreader thermally
7 coupled to the exposed portion of the substrate core and to a backside surface of the
8 integrated circuit.
- 1 2. The method of claim 1, wherein attaching the heat spreader comprises soldering
2 the heat spreader to the exposed portion of the substrate core.
- 1 3. The method of claim 1, wherein mounting the integrated circuit comprises
2 mechanically and electrically coupling the integrated circuit to the top surface of the
3 package substrate by a plurality of solder bump interconnections.
- 1 4. The method of claim 1, wherein the exposed portion of the substrate core
2 extends around the perimeter of the top surface buildup layers.
- 1 5. The method of claim 1, comprising depositing a thermal interface material
2 between the backside surface of the integrated circuit and the bottom surface of the heat
3 spreader.
- 1 6. The method of claim 1, comprising attaching a heat sink to a top surface of the
2 heat spreader.
- 1 7. An apparatus comprising:

2 a package substrate having top and bottom surface buildup layers disposed on a
3 thermally conductive substrate core, wherein a portion of the substrate core is exposed
4 at a top surface of the package substrate to allow for attachment of a heat spreader.

1 8. The apparatus of claim 7, wherein the exposed portion of the substrate core
2 extends around the perimeter of the top surface buildup layers.

1 9. The apparatus of claim 7, wherein the substrate core is made of metal.

1 10. An apparatus comprising:

2 a package substrate having top and bottom surface buildup layers disposed on a
3 thermally conductive substrate core;

4 an integrated circuit having a top surface and a backside surface, the integrated
5 circuit mounted on a top surface of the package substrate with the top surface of the
6 integrated circuit facing down; and

7 a heat spreader thermally coupled to the substrate core, a bottom surface of the
8 heat spreader thermally coupled to the backside surface of the integrated circuit.

1 11. The apparatus of claim 10, wherein the heat spreader is thermally coupled to a
2 perimeter portion of the substrate core.

1 12. The apparatus of claim 10, wherein the heat spreader is soldered to the substrate
2 core.

1 13. The apparatus of claim 10, wherein the heat spreader is made of metal.

1 14. The apparatus of claim 10, wherein the substrate core is made of metal.

1 15. The apparatus of claim 10, comprising a thermal interface material disposed
2 between the backside surface of the integrated circuit and the bottom surface of the heat
3 spreader.

1 16. The apparatus of claim 10, comprising a heat sink attached to a top surface of
2 the heat spreader.

1 17. The apparatus of claim 16, comprising a fan attached to the heat sink.

1 18. The apparatus of claim 10, wherein the integrated circuit is mechanically and
2 electrically coupled to the package substrate by a plurality of solder bump
3 interconnections.

1 19. The apparatus of claim 18, comprising a printed circuit board, wherein the
2 package substrate is mounted on the printed circuit board.

1 20. The apparatus of claim 19, wherein the package substrate is mechanically and
2 electrically coupled to the printed circuit board by a plurality of solder bump
3 interconnections.

1 21. An apparatus comprising:
2 a package substrate having top and bottom surface buildup layers disposed on a
3 thermally conductive substrate core;
4 at least two integrated circuits having top surfaces and backside surfaces, the
5 integrated circuits mounted on a top surface of the package substrate with the top
6 surfaces of the integrated circuits facing down; and

7 a heat spreader thermally coupled to the substrate core, wherein a bottom
8 surface of the heat spreader is thermally coupled to the backside surfaces of the at least
9 two integrated circuits.

1 22. The apparatus of claim 21, comprising one or more capacitors mounted on a top
2 surface of the package substrate.

1 23. The apparatus of claim 21, wherein the heat spreader is soldered to the substrate
2 core.